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RD 54 TASK 5
PROGRESS REPORT #3 - MODEL C

22 MARCH 1956

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OBJECTIVE:

To design and develop a miniature infrared voice communicator and to construct two design approval models.

DATA:

1. Scheduling.

Good progress is being made on the design and development work for the design approval models. The mechanical design of the equipment has been delayed, however, because of lack of definite information regarding the objective and condenser system lens design. The lens design should be completed soon and it is expected that even with the delays involved the two design approval models will be ready for delivery by June 29.

2. Optical System:

a. Lenses.

The breadboard model C system was set up in the dark tunnel and total harmonic distortion measurements were made of the output signal. The transmitter optical system was operated with square aperture and also with round aperture. There appeared to be no significant difference in the amount of distortion measured with the two optical configurations. As would be expected with a system of this type and especially one of limited high frequency response, the principal distortion component is the second harmonic. With a 1000 cps modulation frequency, at a level below the clipping point of the output stage, the measured total harmonic distortion was on the order of 5 per cent.

As a result of these tests it was concluded that a round aperture lens system would be used. A lens opening for the objective of about 1-1/4" was chosen as a good compromise between the requirements of maximum operating range and minimum case thickness.

Several optical companies were contacted regarding the lens design work but none were particularly interested because of the limited quantities of lenses that would be required. Therefore we have undertaken the design. The objective lens design is nearly complete at this time and the condenser should be ready several weeks later.

b. Galvanometer and magnet.

An order has been placed with Midwestern Instruments for 3 galvanometers. Delivery is expected around April 21. In the meantime Midwestern will loan us a standard Model 102-2000 galvanometer for use by us as a sensitivity standard in testing our pole piece and magnet design. This galvanometer should be received very soon.

Sample magnets have been received and a preliminary design pole piece has been made. Flux density measurements indicate that the design is fairly close to our requirements. A more accurate test will be made as soon as the 102-2000 galvanometer is received.

c. Cell.

Sample 1/2 x 1/2 mm Kodak Ektron lead sulfide cells have been ordered. The 1/2 x 1/2 mm size may offer some advantages over the 1 x 1 mm size as used in Model B. The smaller cell, aside from having a somewhat better signal to noise ratio for the same incident flux, also would allow more precise alignment of the communicators because of the narrower angle of view.

3. Amplifiers.

a. Receiver.

The amplifier stabilization is such that the change in gain over the normal range of battery voltages (5.2 to 4.5 volts) is only about 3 db. The normal amplifier gain is about 80 db at 25°C while at -10°C it decreases about 4 db and at 50°C it increases about 3 db. This represents an entirely satisfactory degree of stabilization.

b. Modulator.

A modulator amplifier has been developed consisting of an input stage, a driver, and a push-pull class B output stage. It has a power gain on the order of 85 db and is capable of 85 mw output. A 3000 cps parallel T filter in a negative feedback path around the input stage contributes to the rising frequency response characteristic of about 10 db per octave from 600 to 3000 cps. Although additional work must be done on the temperature stabilization problem, present indications are that with a thermistor in the bias circuit satisfactory output and waveform can be obtained over the desired temperature range.

The tone oscillator for use in equipment aiming is obtained by connecting a positive feedback path from the output stage to the driver.

An oscillator of this type has the advantage of simplicity and requires very few additional components. Since the frequency of oscillation is determined by a number of components in the amplifier it is more difficult to control the frequency, especially over a wide temperature range. However, there is no need for a well controlled frequency in this application and as long as it remains within the range of about 700 to 2000 cps it will be satisfactory.

4. Batteries.

A small battery charger was built for laboratory use in recharging the Gould AA storage cells. The unit charges two cells at a time at about an 80 ma rate. At this rate the cells are recharged in about 10 to 12 hours but may be overcharged indefinitely without damage. The charger is approximately 2-3/4" x 3-1/2" x 2-1/4" including the battery holders. The unit was made with standard components which are larger than actually required for the low charge rate involved.

5. Mechanical.

A sketch showing the tentative outline dimensions and the general appearance of the unit is included at the end of this report. A layout has been made of the complete Model C equipment and several experimental parts for the optical plate are being made in the model shop.

Work has been started on the layout of the mounting boards for the receiver and modulator amplifier components. Because of the limited space available for the amplifiers it will be necessary to solder the transistors in place rather than using sockets. This is no particular disadvantage, however, because of the long service life of transistors.

The four low voltage batteries will be accessible through a hinged door at the back of the case. A single captive screw will retain the door. To remove the entire equipment cover a second captive screw at the back would also be loosened and then the cover could be removed from the frame. The front of the equipment on which the two objective lenses are mounted will be part of the frame.

The control switch and gain control together with the microphone and headset jacks will be on the back. Fold-down type handles will probably be used on the controls to allow an adequate finger grip and yet not increase the overall dimension excessively.

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No field tests or additional range tests were conducted in the last interval. The previously made range tests were entirely sufficient for design purposes. It is hoped that some field tests can be made soon but it is necessary that the design work affecting items purchased on long-lead time be done first.

The lens design will be completed and orders placed for the lens elements. This will allow the mechanical design to proceed satisfactorily.

The modulation indicator design will be completed. Further work will be done on the pole piece and magnet design.

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Report prepared by:

Report approved by:

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